Fabrication of $Cu_{2-x}S$@M (M = C, TiO_2, MoS_2) hollow spheres via self-templating thermolysis strategy with improved lithium storage properties

Yunhui Wang [a], Yiyong Zhang [a], Yueying Peng [a], Jinbao Zhao [a, *]

[a] *State Key Lab of Physical Chemistry of Solid Surfaces, Collaborative Innovation Center of Chemistry for Energy Materials, State-Province Joint Engineering Laboratory of Power Source Technology for New Energy Vehicle, College of Chemistry and Chemical Engineering, Xiamen University, Xiamen 361005, China*

E-mail: wangyh@*stu.xmu.edu.cn*

Conversion reaction-based metal sulfides have shown great attraction in lithium batteries due to high theoretical capacity, abundance and environment-friendly. [1] Nevertheless, some problems such as large volume change, side reactions with electrolytes and loss of active species hinder their further practical applications. [2] To cope with these problems, an all-in-one strategy based on the thermolysis property of sulfides is proposed in this work.

$Cu_{2-x}S$@M (M = C, TiO_2, and MoS_2) uniform and monodisperse hollow spheres were fabricated, utilizing the thermal properties of CuS. The lithium storage properties of $Cu_{2-x}S$@M were also tested. All electrodes, especially the $Cu_{2-x}S$@C-based one, showed superior electrochemical performances compared with the uncoated $Cu_{2-x}S$ one.

The present results demonstrate the general applicability of the proposed strategy for the preparation of coated hollow spheres; the materials prepared by this approach exhibit excellent electrochemical properties. Besides, different core precursors possessing thermolysis properties and coating layers can be employed. We believe that this approach provides an effective alternative route to prepare coated hollow-structured materials for high-performance batteries.

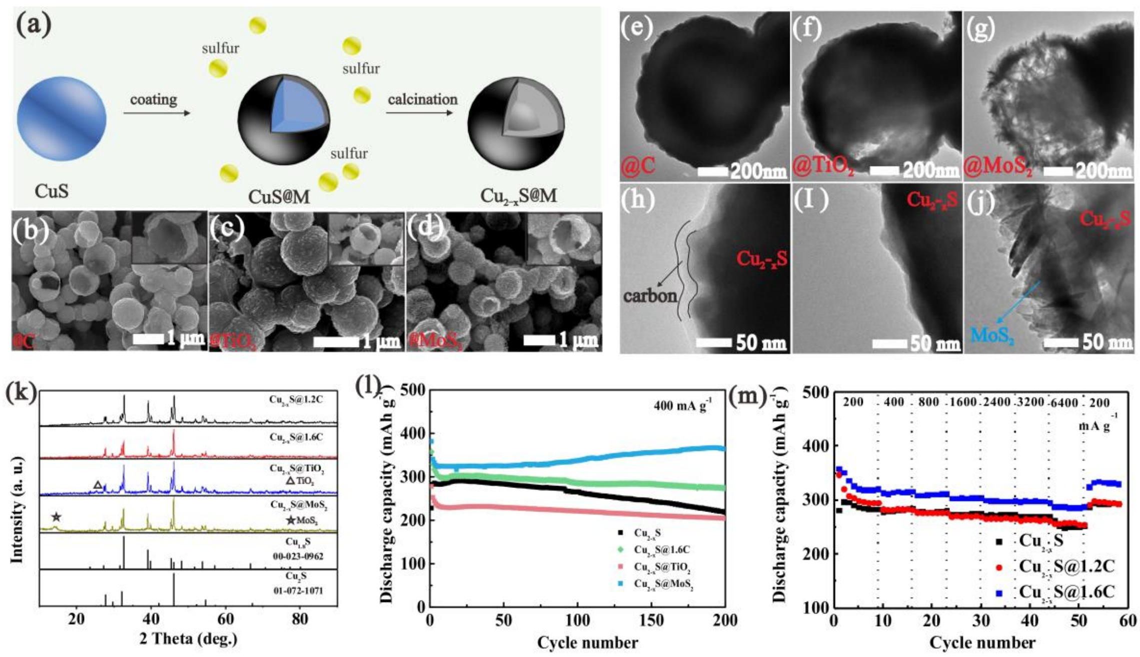

Fig. 1. (a) Schematic illustration of synthesizing coated hollow $Cu_{2-x}S$. SEM images of (b) $Cu_{2-x}S$@C, (c) $Cu_{2-x}S$@TiO_2 and (d) $Cu_{2-x}S$@MoS_2. TEM images of (e, h) $Cu_{2-x}S$@C, (f, i) $Cu_{2-x}S$@TiO_2 and (g, j) $Cu_{2-x}S$@MoS_2. (k) XRD patterns of $Cu_{2-x}S$@M, (l) cycling performances of $Cu_{2-x}S$@C, (f, i) $Cu_{2-x}S$@TiO_2 and (g, j) $Cu_{2-x}S$@MoS_2. (m) Rate capabilities of $Cu_{2-x}S$, $Cu_{2-x}S$@1.2C and $Cu_{2-x}S$@1.6C.

Reference:

[1] J. Cabana, L. Monconduit, D. Larcher, M. R. Palacin, *Adv. Mater.* 22(2010), E170-E192.
[2] M. R. Palacin, *Chem. Soc. Rev.* 38(2009), 2565-2575.